It is true that one may see flints emerging from arctic glaciers unscratched and unrounded, while softer rocks are reduced to strongly striated boulders; but Dr. Irving seems to conceive the Boulder Clay as something distinct from the ice-sheet in which it originated, and as merely pressed on by superincumbent ice. It cannot be too strongly urged that the lower portions of glaciers of the continental or ice-sheet type consist largely of stones and mud and abrading sand-grains, and that these materials are held in the grip of the ice and are moved against one another as it flows. The ice-sheet is, in fact, a conglomerate with an ice cement; the Boulder Clay is an essential part of it, and remains as its representative when the portion that can melt has yielded before climatic change. GRENVILLE A. J. COLE.

Royal College of Science, Dublin, September 6.

Boulder Clay in Essex.

YOUR correspondent Dr. Irving, in his letter entitled "Boulder Clay in Essex" (NATURE, August 22), states that he has made a keen but futile search for a human artefact in the Boulder Clay, and, I presume, infers that these relics do not occur therein.

I have had no opportunity of carefully examining the Boulder Clay of Essex, but for the last six years I have been able to search that of Suffolk, and know that the occurrence of humanly flaked flints in this latter deposit is capable of unassailable demonstration. As until the notification of a human skeleton having been found beneath the Boulder Clay no search had been made in the clay for worked flints, and as that notification was made only a few months ago, I think that perhaps further and more prolonged search in the Essex deposits will reveal some of the type of implements which are found in Suffolk.

But even if this is not so, it cannot be brought as an argument against man's presence here before the deposition of the Boulder Clay. It would be as foolish to argue that because palæolithic implements are not found in a certain section of river-gravel, they do not occur in any other portion of the same deposit.

J. REID MOIR.

12 St. Edmund's Road, Ipswich.

The "Titanic."

YOUR article (NATURE, August 29, 1912) on the report of the Advisory Committee having emphasised the contention from the first of some of us (students of science and old naval commanders) as to the insanity of high speed "at night in the known vicinity of ice," it behoves surely men of science to ask the question whether we have not reached the imperative limits of that false security which the "practical man" is wont to feel in his contempt for scientific "theory"; and, further, whether the time has not therefore come for legislation requiring commanders of the largest ocean-going steamers to hold a diploma, guaranteeing such a systematic course of study (say in a class at Greenwich or Kensington) in marine physiography and the elementary laws of mechanics as would quicken their imagination as to the uncertainty and the magnitude of the risks to be run in an abnormally ice-drifted sea. Lord Mersey's report may whitewash the facts, but the facts *en évidence* remain; and the chain of cause and effect in the lamentable and tragic loss of the *Titanic* leads us in the last resort to the notorious contempt for scientific acquaintance with the facts and laws of nature on the part of the "practical man." A. IRVING.

Hockerill, Bishop's Stortford, September 2.

STUDIES OF AURORA.[1]

ONE or two photographs of aurora seem to have been taken before, but Prof. Störmer is the first to meet with marked success. In the earlier of the volumes before us he describes with full detail the apparatus and methods employed in photographing aurora during a stay of some months at Bossekop, in the extreme north of Norway, early in 1910. Photographs were taken by Störmer and an assistant from the two ends of a base of about $4\frac{1}{4}$ kilometres, simultaneity of exposure being secured by telephonic signal. Using special plates, satisfactory photographs were obtained with a few seconds' exposure. One or more prominent stars were always included in the photograph, and the time was carefully noted. From the known co-ordinates of the stars, it was thus possible to fix the position of the aurora. The base was long enough in general to give a parallax which could be measured with sufficient accuracy to determine the approximate position and height of selected prominent points. The heights calculated for the different auroras varied from 36 to 461 kilometres. Fig. 1 shows a photograph—from the original negative—taken with 3 seconds' exposure; Fig. 2 is an enlargement, the original of which had a 5 seconds' exposure.

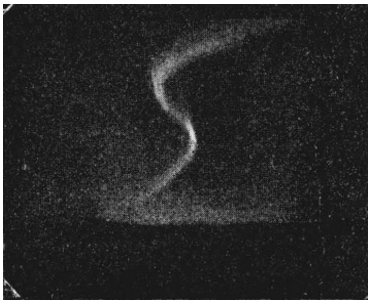

FIG. 1.—Reproduction of a photograph of an aurora: original size.

The second of the two volumes referred to below repeats some of the information given in the first, but is mainly theoretical. Störmer was apparently first attracted to the subject of aurora and magnetic storms by the work of his well-known colleague at Christiania, Prof. Kr. Birkeland, but the views he now holds are independent.

An electrified particle projected in a uniform magnetic field H describes with uniform velocity a helix about the lines of magnetic force. If projected perpendicular to the lines of force, it describes a circle of radius ρ. If m be the mass, e the charge, v the velocity of the particle, and V the velocity of light, then, according to Störmer, $H\rho=(m/e)v(1-v^2/V^2)^{-\frac{1}{2}}$. This differs from the usual formula in English books unless $(v/V)^2$ be negligible, which is far from the case in some of the hypothetical cases dealt with by Störmer. $H\rho$ may for mathematical purposes be regarded as the characteristic constant for a definite species of ray.

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[1] "Bericht über eine Expedition nach Bossekop zwecks photographischer Aufnahmen und Höhenmessungen von Nordlichtern. By Carl Störmer. (Utgit for Fridtjof Nansens Fond.) Pp. 112+88 plates. (Kristiania: Jacob Dybwad, 1911.) Extract from Videnskap. Skrift. Mat. Natur. Klasse, 1911

"Sur les Trajectoires des Corpuscles électrisés dans l'espace sous l'action du Magnétisme Terrestre avec application aux Aurores boréales (second Mémoire). By Carl Störmer. Pp. 163+10 plates. Extrait des Archives des Sciences physiques et naturelles, Geneva, 1912.

In his earliest work, Störmer treated the earth as a uniformly magnetised sphere, of moment $8{\cdot}52 \times 10^{25}$ C.G.S. Assigning to $H\rho$ values ordinarily conceded to kathode rays and β-rays of radium, he found that no electrified particle coming from the sun could reach the earth's atmosphere except in the immediate vicinity of a magnetic pole. If, for instance, $H\rho$ is 1000, the greatest angular distance from the pole is only 3.8°, and to increase the angle to 22°—which answers roughly to the position of maximum aurora—one must assign to $H\rho$ the enormous value 10^6. To account for the observed occurrence of aurora in low latitudes, Prof. Birkeland has had to assume no less a value than 7×10^6, which implies a very close approach in v to the velocity of light.

Prof. Störmer sets out in quest of another explanation. His first idea was to substitute for the field of a uniformly magnetised sphere that derived from the earth's Gaussian potential, based ultimately on the work of Carlheim Gyllensköld. The mathematical difficulties were thereby much increased, while the physical difficulties showed no abatement. Störmer's next idea was suggested apparently by experiments of Birkeland's, which showed that kathode rays in a vacuum tube containing a magnetised sphere can form a luminous ring in the magnetic equator. Störmer supposes a gigantic ring of kathode rays to form and persist for some time in the plane of the earth's magnetic equator, and the auxiliary magnetic field thus produced is believed to render access to low latitudes possible to other kathode rays coming from the sun.

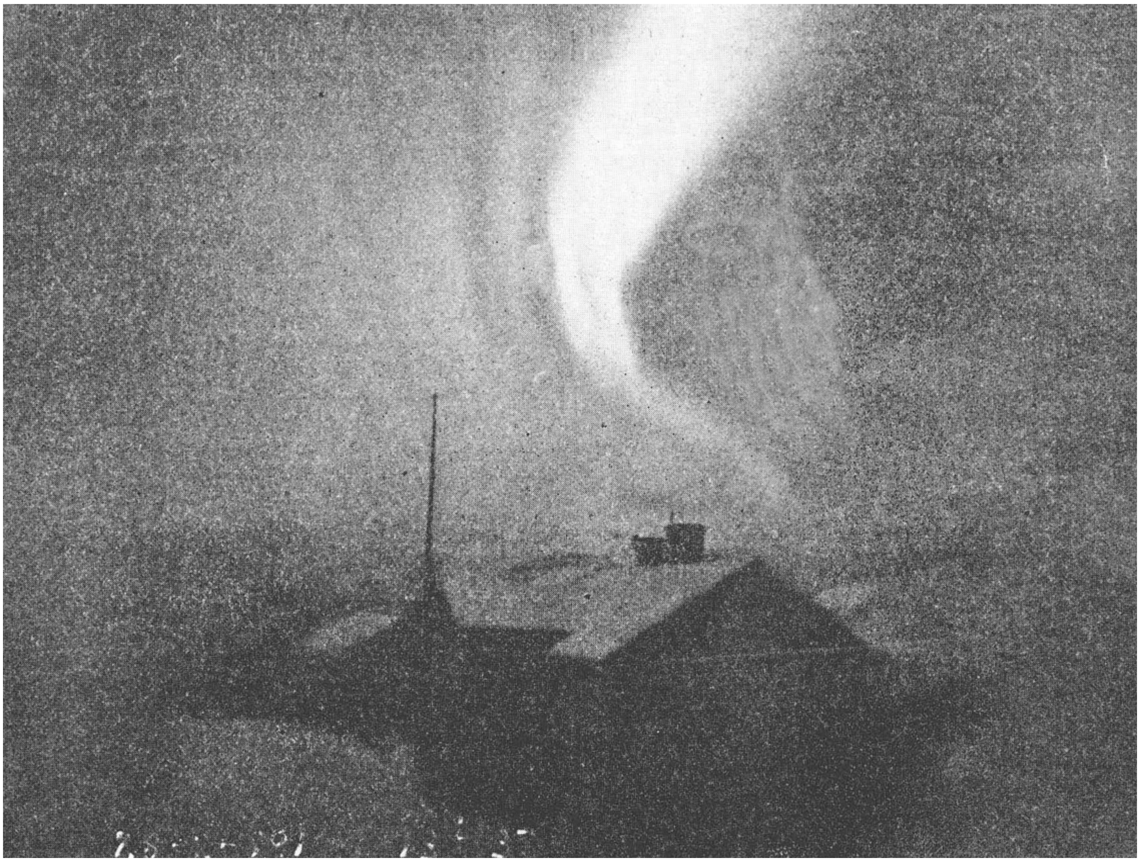

FIG. 2.—Enlargement of a photograph of an aurora on February 28, 1910.

In the absence of a ring, as already remarked, rays require $H\rho$ to equal 10^6 to permit of their getting as far as 22° from the magnetic pole, but this becomes possible to rays the $H\rho$ of which is only 1000, provided there is an equatorial ring of 140 times the earth's radius, carrying a current of about 60 million amperes. The rays forming the ring are supposed to be quite distinct. Their value of $H\rho$ increases from 100 when the ring's radius is 1400 times the earth's to 10^6 when the former radius is 14 times the latter. For a given size of ring, the distance from the magnetic pole which rays coming from the sun can attain increases with the current in the ring. In the case of the largest angular distance considered in detail, 41·6°, the rays forming the ring and those coming from the sun have both 10^6 for their value of $H\rho$, and the

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current required in the ring is 100 million amperes. The magnetic field due to this current at the earth's surface is given as 681γ, which represents a magnetic storm of the first order.

In considering how the question is affected by the presence of the earth's atmosphere, Störmer inclines to the views of Wegener (while not committing himself to the existence of a gas, "geocoronium," of one-fifth the density of hydrogen). At altitudes above 100 kilometres there is supposed to be no trace of anything but the lighter gases, especially hydrogen (and geocoronium, if it exists). In agreement with Lenard, Störmer concludes that ordinary kathode rays coming from space would be absorbed in the upper hydrogen atmosphere before reaching the 100 kilometres level, that β-rays of radium would be absorbed in the nitrogen atmosphere at heights of 50 to 70 kilometres—a common altitude for the lower border of auroral "curtains"—and that the rays forming the lowest aurora he has measured must have a greater penetration than β-rays. Fairly substantial evidence has been advanced by Paulsen and others that auroras in the auroral belt, especially in Greenland, sometimes come much below the lowest height, 36 kilometres, observed by Störmer at Bossekop. This tends to support Birkeland's latest views as to an enormously high velocity in the rays if they originate in the sun. On the other hand, there seems reason to accept Störmer's view that auroras seen in low latitudes are usually at considerably greater heights than those seen in the Arctic. Thus aurora in low latitudes would seem to arise from rays of less, not of higher, penetration than those in high latitudes, which seems inconsistent with Birkeland's hypothesis.

Störmer's mathematical work, like Birkeland's, assumes the motion of the individual corpuscle to be unaffected by the presence of other corpuscles. This is one of the principal criticisms urged by Prof. Schuster,[2] who concluded that the scattering inevitably produced is fatal to Birkeland's theory, so far at least as magnetic storms are concerned. The same criticism would seem to apply, with at least equal force, to Störmer's theory. It would thus be of great interest to have Prof. Störmer's views on the validity of Prof. Schuster's criticisms. Meantime, considering the calibre of the protagonists, the prudent course seems to be to "wait and see." But whatever the fate of Störmer's theoretical work may be, his photographs of aurora clearly constitute a fundamental advance towards exact knowledge. In temperate and southern Europe, aurora and large magnetic storms are both rare events, and their coincidence of occurrence seems the rule rather than the exception. A total absence of physical connection between the two phenomena seems thus almost inconceivable. The careful intercomparison of measurements of aurora—rendered possible by Störmer's work—with contemporaneous records from magnetic observatories is clearly one of the most promising methods of getting at the root of the matter.

C. CHREE.

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[2] Roy. Soc. Proc., A. 85, 1911, p. 44.

PROF. THOMAS WINTER.

PROF. THOMAS WINTER, of the University College of North Wales, Bangor, whose death we recorded in our last issue, was the son of Mr. Thomas Winter, of Lotherton Park, Aberford, Leeds. Born in 1866, he was educated at the Darlington Grammar School under Dr. Wood, and afterwards proceeded to the University of Edinburgh, where in 1888 he graduated in arts with honours in natural science. On leaving the University he became a master at a Scarborough school, and later at the Norfolk County School at Dereham. The son of a successful practical farmer, and equipped with a university training in natural science, he was naturally attracted to the development of schools of agriculture in the provincial colleges and universities which marked the later decades of the last century. In 1891 he was appointed assistant lecturer in agriculture at the University College of North Wales, Bangor. In 1892 he accepted a similar appointment at the Yorkshire College, Leeds, as it then was, but returned in 1894 to Bangor as head of the department of agriculture, a post which he occupied for the next eighteen years. It is thus in North Wales that his life-work chiefly lay, and where the stimulus which he gave to the cause of agricultural education will be longest felt.

The work of a school of agriculture has its internal and external sides. On the internal side courses of instruction have to be provided with a view to certificates, diplomas, and degrees. On the external side the agricultural community within the area served by the school has to be considered, and extension lectures, field experiments, and instruction in dairy-work have to be provided for the benefit of those who cannot reach the college. In both these aspects of the work of his chair, Prof. Winter achieved a rare success. Within the University of Wales his sound judgment contributed to the framing of the existing scheme of instruction for the degree in agriculture and rural economy, the marked feature of which is the requisition of an adequate acquaintance with the pure sciences, prior to the study of their applications to agriculture. It was also to Prof. Winter's fostering care that the chair of forestry was established at Bangor.

In the external work of the department his gift of organisation and his tact and good sense have greatly contributed to the removal of the distrust of agricultural education among old-fashioned farmers. Not the least contribution to this end was his successful management of a college farm, where experiments in cropping and breeding have been carried out, and where the visits of farmers and their sons and daughters have always been welcomed. Prof. Winter's death while still in the prime of life will be greatly deplored by his colleagues on the senates of his college and university, by his former pupils scattered in many parts of the world, and not least among the farmers of the North Welsh counties.